

C O N T R A C T U R E S   F O L L O W I N G

G U N S H O T   W O U N D S .

( I N C L U D I N G   H Y S T E R I C A L   C O N T R A C T U R E S )

A N D   T H E I R   T R E A T M E N T .

— BY —

J . S T A N L E Y   L L O Y D .



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One of the commoner disabilities now met with as the result of gunshot wounds of the late war is a contracture. The Highbury Orthopaedic Hospital, Birmingham, is the principal centre for the West Midlands for the treatment of disabled ex-service men, and I propose to illustrate this thesis with cases which have been treated at this Hospital.

These cases include contractures following:-

- (1). injury to the central nervous system.
- (2). injury to the peripheral nerves.
- (3). injury to the muscles and tendons.
- (4). injury to the joints.
- (5). any injury with resulting hysterical contractures.

The methods adopted in dealing with these disabilities are directed towards firstly, repair of the initial damage, if possible, and, secondly, correction of the deformity itself.

I wish to point especially to the correction of the deformities by means of plaster-of-Paris splints, and also to the restoration of function in certain cases by means of transplantation of tendons, as we have had recourse to these procedures in a very large number of cases at Highbury, with results which have

been very satisfactory on the whole. The less successful cases have naturally been those in which considerable bony changes in the joints had supervened. A few functional cases have also resisted treatment by suggestion. Perhaps these latter cases could be classed under the Reflex Contractures of Babinski and Froment.

#### ETIOLOGY OF ORGANIC CONTRACTURES.

Organic contractures are generally produced as the result of injury to the nervous system, but may be the consequence of damage to the muscles or joints.

Any injury to the central nervous system affecting the motor tracts may result in a contracture. A lesion of the upper motor neurone, if the lower motor neurone is intact, produces, after a short period of flaccidity, a spastic paralysis in the muscles supplied by the affected fibres. It is found that the flexors usually overcome the extensors and the result may be a contracture (Extension of the ankle, i.e. plantar-flexion of the foot, is really a movement of flexion).

A lesion of the lower motor neurone or of the peripheral nerve may result also in a contracture. If the function of the nerve is seriously interfered with, or is lost, the antagonistic muscles, having

nothing to oppose their action, may succeed in bringing about a deformity. This is frequently seen in lesions of the musculo-spiral nerve, which on account of its anatomical position is very susceptible of injury. The triceps muscle receives its branches high up and usually escapes, but the extensors of the wrist, fingers, and thumb are paralysed. No opposition being offered to the flexors of the fingers and wrist, the hand assumes the position known as wrist-drop, with perhaps flexion and adduction of the thumb.

Division of the ulnar nerve is nearly always characterised by flexion of the 4th and 5th fingers. This is due to the fact that the Lumbricals of these fingers, being supplied by this nerve, are paralysed, whereas those of the index and middle fingers are supplied by the median nerve. The extensors of the 4th and 5th fingers are not strong enough to withstand the action of the muscles supplied by the median nerve and the result is that the Flexor Sublimis Digitorum produces a contracture.

Injury to the median nerve does not usually cause a contracture.

In the lower limb contracture is frequently met with as a result of injury to the great sciatic nerve or to the external popliteal. When the sciatic is divided the result is a complete paralysis of the leg below the knee. The weight of the foot alone with the assistance of the weight of the bedclothes, will, if not looked after, cause foot-drop.



If the external popliteal alone is injured the unopposed action of the calf muscles will cause the same condition, and in a more marked degree.

Contracture of the great toe or the smaller toes is sometimes met with, but the condition is usually a protective one, to avoid pain by pressure on the sole of the foot. It has nothing to do with a lesion of the nerve supplying the antagonistic muscles, and is not a functional contracture such as will be described later.

A gunshot wound involving a muscle or tendon may cause a contracture by the replacement of the normal tissue by fibrous tissue. This always has a tendency to contract with the result that deformities are produced if care is not taken to avoid them.

This is commonly met with in the flexor muscles of the forearm, and in the calf of the leg. The wound, being usually septic, causes adhesions between the muscles or tendons and the adjacent structures, and thus renders the condition a very difficult one to treat.

A wound involving a joint may easily result in the limb assuming a mal-position if not carefully looked after. Prolonged immobilisation of the joint in a bad position results eventually in the tendons

passing over the joint becoming shortened owing to the fact that they are never stretched out to their full extent.

#### ETIOLOGY OF FUNCTIONAL CONTRACTURES.

During the late war there was a large number of men who suffered from what is commonly known as "shell-shock". Crile, ("Surgical Shock" - Crile & Lower) is of opinion that the essential pathology of shock is identical, whatever may be the cause from which it arises. Mott, in his Lettsomian Lectures (Feb. 1916 to the Medical Society) stated that the majority of shell-shock cases had an acquired or in-born predisposition to emotivity, with the result that they were less able to withstand the terrifying effects of shell-fire and the stress of trench warfare. No known methods of microscopic investigation could demonstrate any pathological changes in the central nervous system of soldiers suffering from war psycho-neuroses. In the great majority of cases of emotional and commotional shock the patient recovers after a variable time, but in hysterical patients some part of the field of consciousness remains affected, and the result is mutism, psychic blindness, or deafness, paralysis, tics, tremors, contractures etc.

These psycho-neuroses consist fundamentally in the exaggeration and perseveration

of instinctive defence reactions, incidental to normal physiological conditions, viz., protective pain, fatigue, and emotion.

Babinski ("Hysteria or Pithiatism" - Babinski & Froment) defines hysteria, or pithiatism, as he prefers to call it, as a "pathological state manifested by symptoms which it is possible to reproduce by suggestion in certain subjects with a perfect exactitude, and which are susceptible of disappearing under the influence of persuasion (contra-suggestion)." He thus regards all hysterical contractures as curable by suggestion and puts into a special category reflex contractures and paralyses arising in consequence of a wound or traumatism, which without showing the characteristics of motor organic disease are to be distinguished from functional disorders by the absolute inefficacy of psychotherapy.

Mott (War Neuroses & Shell Shock) is undecided as to whether such contractures are due to a reflex irritability of the motor cells of the spinal cord or to reflex inhibition of the motor cells presiding over the groups of muscles which oppose those in contracture, or whether the condition is the result of myogenic changes. He disagrees with Babinski in assigning to the sympathetic nervous system an important rôle in the causation of such contractures and cites cases in

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which the vaso-motor thermal and secretory disturbances were probably due to hysterical immobility as shown by the fact that they disappeared on the patient being cured by physio-psychotherapy.

Mott describes three stages in the development of hysterical contractures and paralyses:

- (1) An instinctive reflex defence reaction, often against pain, by immobilising the affected part.
- (2) The psychogenic stage in which there is perseveration and exaggeration of this defence reaction.
- (3) Late phenomena of prolonged immobility, viz., wasting of muscles, adhesions in joints and their fixation, associated with vaso-motor, thermal, and secretory disturbances.

#### SYMPTOMATOLOGY & DIAGNOSIS.

In treating a patient suffering from a contracture, the first step is to decide whether the condition is functional or of organic origin. If there is no obvious destruction of muscular or joint tissue it is presumably due to involvement of the nerve supply or is functional in nature. It is often possible to say at a glance to which category the deformity belongs.

If the causal injury is not too recent certain changes occur in the muscles if deprived of their nerve supply. A few days after division of the nerve the electrical phenomena known as "the reaction of degeneration" commence to appear. In



consequence of the destruction of the nerve the muscle is no longer susceptible to stimulation by means of the faradic current. The muscular tissue itself will still respond to galvanism but as time goes on, unless continuous stimulation with the galvanic current is given to preserve the muscle from degeneration, it ceases to respond even to this, growing gradually more and more sluggish, until the complete R.D. is found and eventually all contractile tissue is lost and what remains is nothing but a fibrous band.

The wasting of muscle consequent upon nerve injury is quite obvious, and easily distinguished from the almost normal muscular bellies, which are found in functional paralysis. In the latter case there is no reaction of degeneration and all the muscles respond equally to faradism and galvanism. It should be noted that in doubtful cases it is advisable to warm the limb before deciding that response to the faradic current is diminished or absent. In the case of lesion of a mixed nerve there will also be sensory and trophic changes to be found in the area supplied by the sensory portion. Anaesthesia, hypothermia, cyanosis, hyperidrosis, and oedema may result. It is true that hyperthermia, cyanosis, hyperidrosis and oedema may also occur in a functional lesion from prolonged immobility of the limb but as a rule they are not so marked. Anaesthesia if present will be found to be of the stocking or gauntlet variety and does not coincide with the anatomical distribution of any sensory nerve.

Hysterical contracture of a limb is marked by its intensity, the joints being firmly immobilised so that the whole limb is rigid. It is possible to overcome the contracture by the sudden application of force, but the limb immediately returns to its former position. If the patient be directed to straighten the limb voluntarily it will be found that the antagonistic muscles go into spasm before any flicker of movement can be discerned in the paralysed group.

An organic contracture takes a considerable time to develop and thus differs from a functional one by the fact that the latter appears either immediately or a short time after injury.

In old-standing cases of functional paralysis the phenomena of prolonged immobility appear. The muscles become more wasted and changes in the tendons, ligaments and joints are found. Thus after a time there may be a real shortening of the muscles on the inner side of the contracture. Such a one is illustrated below. (Case 11).

Here a condition which was probably capable of easy cure by psycho therapy 3 or 4 years ago has now become so fixed in the unnatural position that it is impossible to restore the hand to its normal condition.

There are some cases met with in which there is a functional condition super-imposed upon an organic lesion. These cases often present great

difficulty in diagnosis and in treatment. The functional element may be successfully treated but there is a residuum which fails to respond to suggestion and re-education: One finds that after a certain improvement following suggestion, the progress towards recovery ceases. When this stage has been reached further treatment must be directed towards the organic part of the contracture. This is frequently met with in cases of drop-foot who present themselves for treatment with complete loss of voluntary power in the anterior tibial group of muscles and whose Tendo-Achillis appears to be shortened. By re-education the function of the anterior tibial group can be restored, and sometimes satisfactory relaxation of the posterior group obtained to permit of full movement of the foot. In many cases however, it is found that division of the Tendo-Achillis is necessary before a full range of movement in the foot is possible.

The cases grouped together by Babinski & Froment under the name of Reflex Contractures present no evidence of organic injury to peripheral nerves. The wasting of the muscles, the trophic changes in the joints, and the complete absence of volitional movement are strongly indicative of a true paralysis, but it is found that the electrical responses are little, if at all, affected. The only differences which Babinski makes between a reflex and a functional contracture are

(1) the trophic changes are more marked in reflex contractures, and



(2) no improvement can be obtained by psycho-therapeutic measures.

Babinski draws a close analogy between the etiology of this reflex contracture and atrophy of muscle following on injury to or inflammation in a joint controlled by those muscles, e.g., wasting of the Quadriceps Extensor after knee-joint disease.

#### TREATMENT OF ORGANIC CONTRACTURES.

An injury to the upper motor neurone causes, as has been said, a spastic paralysis. A certain improvement can sometimes be obtained by re-education of the patient in the use of the limb, but even so it will be found that there is a good deal of spasm which it is difficult to overcome. The flexors being stronger than the extensors cause a contracture of the limb and the small amount of voluntary power present in the extensors is not enough to counteract the continuous action of the flexors.

One such case is described below, with the treatment carried out.

Case 1. 20008 Pte. H. Brooks, K.R. Rifle Corps, was wounded in the right parietal region in July 1915. He was admitted to Highbury Hospital on the 8th September, 1919, and his condition then was as follows: - The scar was healed, and there was a gap in the skull the size of a half-crown. There was slight wasting of



the whole of the left arm and left leg. The chief disability was that he was suffering from a spastic flexion of the wrist and fingers and of the foot (foot-drop). A spring was applied to his boot to hold up his foot and he was re-educated in the use of the arm. His condition improved a little under treatment, but there was still the unbalanced action of the flexors over the extensors, and he was unable to extend his wrist or fingers.

It was decided that there was no likelihood of further improvement and that an attempt should be made by operation to restore the balance by transplanting tendons from the flexor to the extensor side of the forearm. This was done on the 13th July, 1920. The Flexor Carpi Ulnaris was detached from its insertion and brought round the inner border of the forearm to be sutured to the Extensor Carpi Ulnaris, the extensors of the fingers and to the Extensor Longus Pollicis. The Flexor Carpi Radialis was similarly brought across the outer side and inserted into the Extensor Ossis Metacarpi Pollicis and Extensor Brevis Pollicis.

After ten days the patient commenced treatment for re-education of the transplanted muscles in their new position. He was, of course, just as spastic as before operation, but the flexors no longer overcame the extensors, and such power as he had over his muscles he was able to use to the best advantage. He could flex or extend his wrist and fingers, although

all movements were slow, and the function of the hand was greatly improved.

In the case of a contracture which has followed upon a wound of a peripheral nerve one should first make an attempt to restore the function of the nerve by suture. It is not known what length of time may elapse after division of a nerve before the nerve has become so degenerated that regeneration following suture is impossible, but the longer the period the less the chance of recovery. I have certainly seen regeneration take place after more than two years had elapsed between the date of the wound and of the suture. End-to-end anastomosis is the only operation which stands any chance of success. If this is not possible the nerve bulbs may be stitched together with the limb flexed, if such procedure will help - as in the median nerve and in the ulnar nerve if it has been transplanted to the front of the elbow, and in the great sciatic nerve. The limb is then fixed for 4 -6 weeks and then gradually straightened after which the nerve has been stretched sufficiently to allow of the ends being brought together after the nerve bulbs have been excised.

Six weeks after suture one may commence to treat the contracture. Passive movements of the joint should be made and the limb immersed in hot water or wax baths. If the contracture can be fairly easily corrected nothing more may be required than

the wearing of metal splints which are adjusted daily to correct the deformity. In cases of long standing however, such splints are not sufficient to deal with the condition and recourse should then be had to plaster-of-Paris splints. The mechanism of this treatment will best be seen by reference to the accompanying photographs of cases in the different stages of treatment.

Treatment by plaster-of-Paris splints with gradual correction of the contracture is best suited for wrist and finger contracture. It depends for its success, upon the fact that if continuous pressure be made on a contracted muscle, tendon, or ligament, it will stretch. Thus a few days later a splint which was previously tightly pressing on the contracture will be found to be slack, and capable of closer adjustment. This procedure is repeated until the deformity is corrected.

#### CONTRACTURE AT THE WRIST.

A contracture at the wrist is a common deformity and one which is very disabling and I will first describe the procedure followed in such a case.

The forearm and hand are covered with stockinette extending from well above the elbow to the tips of the fingers. This is then well covered with American wool, special care being taken that the bony points at the elbow and wrist are well padded. A plaster case is then applied all over, leaving the



thumb free. The plaster is allowed to dry for two or three days and then the splint is ready for wedging.

Wedging is performed by sawing through the splint on the concave side of the contracture, leaving the convex side intact. Pressure is then applied so that a gap is produced on the concave side, the lower portion of the splint hinging on the uncut portion at the back. A cork wedge, a half to one inch in thickness, is then fixed in the gap, and the whole covered with a few turns of a plaster bandage. The splint will then be found to be pressing very tightly on the palm of the hand. Four or five days later, the splint will probably be found to be slack, the limb having accommodated itself to the new position. The process is then repeated by again sawing through the splint on the front of the wrist and inserting another wedge.

This process of gradual wedging must necessarily be a little painful, but if it is done judiciously, a little at a time, it is certainly not beyond the ability of the most faint-hearted patient to bear it.

If there is much distortion of the limb it may be necessary to remove the plaster after a few wedgings and reapply it. This will also avoid hyperextension at the finger joints, which should never occur if proper care is taken in exerting the pressure



along the whole surface of the hand.

The deformity having been corrected, the great difficulty is to prevent it relapsing. An anterior splint extending from above the middle of the forearm to the tips of the fingers should be applied. This should be removed daily for treatment which should consist of passive and active movements and hot baths. A shorter splint extending only to the middle of the palm may be applied later in order to allow of free movements of the fingers. After a time there will usually be no tendency to relapse and the patient may be dismissed from treatment with instructions to wear the splint at night for a time. Later it may be dispensed with altogether.

#### Contracture of Fingers.

The ring and little fingers are the ones most frequently met with in contracture. If the contracture is due to shortening of the flexor tendons without changes in the joint, it will usually be found that full flexion of the wrist will enable one to extend the fingers - partially, at any rate. The wrist should therefore be fully flexed before applying the plaster and the fingers extended to the full range possible. Gradual wedging at the wrist, as has been described above for contracture of the wrist, will enable one to overcome the deformity. Repeated applications of plaster may be necessary before this is fully accomplished.

(Contracture

Contracture of the Thumb.

This can be corrected also by a plaster splint applied to the forearm and hand. A small block of plaster should be built out on to the palm close to the thumb which should then be forced gradually outwards by means of pieces of felt applied between this block and the thumb.

Stiff Metacarpo-Phalangeal Joints.

In any injury of the hand it is very frequently found that the metacarpo-phalangeal joints become stiff. These can be corrected by means of plaster as follows: -

A plaster case is applied as before, extending from above the elbow to the tips of the fingers. When dry, the part in front of the fingers is cut away and pads of felt are applied behind the fingers. This pad is increased at intervals of about four days and is kept in place by means of a few turns of plaster bandage. It will be found that in six to eight weeks even the stiffest fingers have been mobilised. A retaining bar is then applied to hold the fingers in position after the plaster has been removed. This can be removed during the treatment of the fingers by baths etc., and it will effectively prevent relapse until the structures have accommodated themselves to the new positions.

In the same way flexion at the knee-joint may be corrected by means of wedging a plaster case

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applied from high up the thigh to above the ankle. A shortened Tendo-Achillis or an inversion of the foot is capable of being similarly treated. Turner's splint is useful in case of contracture at the elbow or knee. The photographs of the splint in use will explain its mechanism.

#### Contractures following Injury to Muscles &c.

Contractures following gun-shot wounds of muscles or tendons may be corrected in a similar way by the application of plaster-of-Paris splints, with a view to stretching the scar-tissue formed. If the damage has not been too great a considerable degree of success can be obtained. More serious damage however, may necessitate surgical interference.

In all cases of contracture it is advisable to have a radiogram taken of the affected joint: Gross bony changes may have to be met by surgical measures, but a mild degree of bony block can usually be overcome by plaster.

This treatment by means of plaster has been carried out in a large number of cases at Highbury during the past three years, and the results have proved to be much more satisfactory than could be obtained by any other method hitherto attempted. Gradual correction does not cause the local reaction which is met with when a contracture is forcibly and abruptly corrected under a general anaesthetic, and the results show that there is much less likelihood of a relapse.



Tendon Transplantation to Restore the Function  
of a Hand after Organic Contracture.

In a case of paralytic contracture of the wrist due to destruction of the musculo-spiral nerve it is not enough to overcome the contracture, but something further must be done to restore the function of the hand. Suture of the nerve may be impracticable, or if performed, may lead to no regeneration - perhaps from being too old-standing. The only other procedure to adopt is a transplantation of some of the flexors to the back of the hand. This is, of course, a surgical measure, but the after-care is one which usually falls to the physician in charge of the Electrical & Massage Depts. of a Hospital; and it is upon the efficiency of this after-care that so much depends in procuring a good result.

The operation as performed at Highbury is as follows: -

Flexor Carpi Radialis is transplanted to: -

- (1) Extensor Ossis Metacarpi Pollicis.
- (2) Extensor Brevis Pollicis.

Flexor Carpi Ulnaris is transplanted to: -

- (1) Extensor Longus Pollicis.
- (2) Extensor Indicis Proprius.
- (3) Extensor Communis Digitorum.
- (4) Extensor Minimi Digiti.

Pronator Radii Teres is transplanted to: -

- (1) Extensor Carpi Radialis Longior.
- (2) Extensor Carpi Radialis Brevior.

The after treatment commences about six days after the operation, when the reaction from the operation has subsided. The patient is directed to move his

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fingers while still keeping them on the splint which is affixed to hold the fingers and thumb in extension. Ten days after operation gentle faradism is applied to the transplanted muscles and the patient is directed to attempt the movements of extension himself. The mechanism of the new actions of the transplanted tendons is explained to him and he is told that if he tries to flex his wrist the result will now be extension of the fingers and thumb.

It is advisable to attempt, before operation, to make the patient practise individual contractions of the flexors of the wrist, but while some men succeed in doing this it is not always possible.

Passive movements of the fingers, increasing gradually in range, should be made ten days after operation and faradism continued until the patient is able to make the necessary movements voluntarily. A short anterior splint extending only to the palm of the hand should be exchanged for the long one about two to three weeks after operation. A great deal depends upon the intelligence of the patient in obtaining a good result. Some men can re-educate themselves in a short time, while others take weeks to achieve equal progress. A patient (Pensioner Smith) suffering from musculo-spiral paralysis, was operated on for tendon transplantation at Highbury on July 11th, 1921. He was discharged

from treatment on September 5th with full control of his hand, its function being not much inferior to a normal one.

Tendon transplantations in the leg and foot have not been found to be very successful on account of the difficulty of re-educating the limb. It would appear that as the movements of the foot are of a coarser nature than the fine and delicate movements which are possible in the hand, that the brain is incapable of adjusting itself to any alteration in function of individual muscles. For this reason tendon transplantation of any muscles of the lower limb, other than those of the same group, have now been abandoned at this Hospital.

The following cases, treated at Highbury, are illustrative of organic contractures and the result of treatment.

Case 2. 20086. Pte. E. Manders, Royal Warwickshire Regt., was wounded in the left hand and wrist on 27/8/17. He was admitted to Hospital on 2/11/20. He then had a deep scar over the base of the thumb. The extensors of the thumb were cut and it was flexed into the palm. The little finger was flexed into the palm.

Plaster-of-Paris splints were applied to wedge out the thumb and straighten the finger. This was successfully effected, and an operation was performed on 19/3/21 to excise the scar and projecting bone at the wrist and to transplant the tendon of the Extensor Carpi

Radialis Longior to the Extensor Longus Pollicis. The usual treatment was then given for a transplanted tendon and the joints were kept mobile with baths and massage. He was discharged from Hospital on 7/9/21 with his hand functioning quite well. He was able to extend and flex his thumb and the movements of his fingers were good. (See Photograph).

Case 3. -

1344. Pte. A. Comerford. King's Royal Rifle Corps.

This man received a wound in the forearm in March 1918, involving the ulnar nerve. This was sutured in January, 1920. He was admitted to Hospital in June 1920, suffering from contracture of the 3rd, 4th and 5th fingers. (See Photograph).

He was treated by plaster and the fingers wedged out, but the ring finger was so badly damaged that it had to be amputated. Subsequently to the plaster treatment the patient received massage and baths for the fingers. He was discharged in March 1921, with the hand in the condition shown in the second photograph, and with a very good function.

Case 4. -

3134. Pte. William Taylor, Worcester Regt., was wounded in August 1917 in the left upper arm, the musculo-spiral nerve being divided. The nerve was sutured in January, 1918. He was admitted to Hospital in March 1920, with wrist drop, the wrist being stiff. He was treated by plaster wedging in order to mobilise the wrist, this

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being performed successfully. The metacarpo-phalangeal joints being stiff, plaster was used to correct these also.

He was operated on in April 1921 to transplant the Flexor Carpi Ulnaris to the extensors of the fingers and the long extensor of the thumb, the Flexor Carpi Radialis being re-inserted into the short extensors of the thumb and the Pronator Radii Teres to the radial extensors. He received the usual treatment after operation.

Function of the hand is now good. He can flex and extend the fingers, thumb and wrist, although the movements are somewhat stiff, owing to the long period that elapsed between the wound and the commencement of treatment.

#### TREATMENT OF FUNCTIONAL CONTRACTURES.

A functional contracture is brought about by a combination of spasm of the muscles on one side with a functional paralysis of those on the other.

In the treatment of functional contractures it is desirable, in the first place, to demonstrate to the patient that there is no real paralysis to contend with; and he should be assured that proper treatment will bring about a rapid cure. The application of the faradic current to the apparently paralysed limb should be sufficient to satisfy the patient on this point.

The first stage in the treatment of a contracture is to eliminate the spasm. Re-education in the use of the opposing muscles should afterwards be a fairly easy matter. The patient should be taken to a quiet room and made to lie down on a couch, as this is the only attitude of the body which requires no effort to maintain. He should then be told that what is desired is that he should relax all the muscles of the body. By making passive movements of the sound limbs one can demonstrate what relaxation means. It is frequently by no means easy to get a patient to let himself go, and some cases may take two or three hours before they submit to allowing their limbs to be moved into any position without making some effort at resistance. It is occasionally found that a patient who has at last succeeded in bringing about a complete relaxation of all the muscles of the body has also managed to detach himself from interest in all other things surrounding him, and has fallen asleep.

Having succeeded in producing as complete relaxation as possible on the part of the patient, one should next direct one's attention to the contracted limb. This will usually be found to have improved considerably, but on the man's attention being drawn to it by handling it, the muscles tend to go into spasm again. The patient should be instructed to let these muscles relax as he did before with the other muscles. Gentle passive movements may help him in this and usually a considerable degree of spasm may be made to disappear.

When this has been satisfactorily effected the next step should be to make the patient make a voluntary effort to hold the limb in extension after it has been placed there. When he succeeds in this he should be instructed to move the limb from flexion to extension.

Considerable time and patience may have to be expended before such a result has been attained, but it is much better to do all that is necessary in the first session of treatment rather than to leave the process unfinished, as one would probably have to start at the beginning next day.

A contracture of recent origin may be completely cured in one sitting, while more old-standing cases require the assistance of splints to overcome the condition. This is more likely to happen in cases which have certain changes - however slight - in the joints and soft structures producing a feeling of stiffness in the parts. In such cases a splint applied to the flexor side should be employed and massage given and movements of the joints made. In any case the patient should soon be put on to gymnastic exercises designed to re-educate and strengthen the affected muscles, and to move the joints which have been immobilised.

Where grosser changes in the joints have followed prolonged immobilisation recourse may be had to some of the methods previously described for treatment of organic contractures. It sometimes



happens that a finger has become so deformed from the unnatural position adopted that any attempt to restore it to function is useless, and it has to be amputated.

The following are examples taken from many cases treated at Highbury.

Case 5. 9500. Pte. Albert Batchelor, Royal Warwickshire Regt., was wounded in the right upper arm in March 1915. He was admitted to Highbury on 14/2/21. His condition then was that there was wasting of all the muscles of the arm and almost complete apposition of the thumb and little finger. The hand was in the position known as "accoucheur's hand". There were slight flickers of contraction in the wrist and fingers when he attempted to make a voluntary contraction. There was a dulling of sensation over the skin supplied by the ulnar nerve. The hand was blue and cold and wet from perspiration. All muscles responded to faradism.

The man was treated in the way described above. The condition was of such long standing (he stated it had been in that condition since shortly after he was wounded) that it was necessary to resort to baths and massage in order to get the movements free. He was discharged from Hospital on 12/7/21 fit for work with full function of the hand and normal sensation. He had been employed for some weeks previous to discharge in the curative workshops attached to the Hospital where he learnt to use the hand equally with the sound one. (See Photograph).

Case 6. 5123. Pte. Thos. R. Lilley, King's Royal Rifle Corps, was wounded on 27/9/14 in the forefinger. He was admitted to Hospital on 3/9/19 with his hand extremely distorted. The wrist was flexed and the thumb and little finger were enclosed in the palm with the other fingers tightly fixed over them. He received psycho-therapeutic treatment and five days later was able to extend all his fingers and the wrist. The little finger was so much distorted that amputation was necessary, and this was performed at the proximal interphalangeal joint on 21/10/19. He was discharged from Hospital on 12/11/19 with his hand in normal condition. (See Photograph).

Case 7. 9742. Pte. John Begley, King's Royal Rifle Corps, was wounded in the left forearm in May 1915. He was admitted to Hospital on 30/9/20, and was then unable to extend the thumb or the hand. Electrical examination of the muscles supplied by the posterior interosseous nerve showed no abnormality. He was treated by psycho-therapy and in three days his hand was functioning normally. He was discharged from Hospital, fit for work, on 11/10/20. (See Photograph).

Case 8. Pte Wm. Siddaway, South Staffs, Regt., was wounded in June 1918 in the right hand. He was admitted to Hospital in November 1919. He then had signs of a fracture of the 1st and 2nd metacarpal bones, which had united in good position. The hand was closed in the position shown in the photographs and the fingers were

very spastic. He was treated by psycho-therapy with the result that in three days he was able to open his hand and use it, although it was of course stiff. He was given massage and baths and later gymnastic exercises for the hand, and was discharged in January, 1920, with a perfectly good hand.

Case 9. 121143, Sgt. C. Symonds, Royal Garrison Artillery, received a gun-shot wound of the right upper arm and forearm in August 1918.

He was admitted to Hospital in January, 1920, with his hand and arm in the position shown in the photograph, the elbow being flexed to a right angle and the wrist acutely flexed. The metacarpo-phalangeal joints were also stiff.

He was treated by psycho-therapy and soon was able to move his elbow freely. His wrist was more obstinate and remained in the position shown in the second photograph. All the muscles in the arm reacted to faradism.

Plaster treatment was then adopted in order to overcome the alterations in the wrist-joint. This was successful and the wrist was completely straightened and in fact dorsiflexed. Massage and baths were then given to make the joints more freely movable and then the stiff metacarpo-phalangeal joints were treated by plaster in order to make them mobile.

The condition now is that the movements of the hand and wrist are free and all the extensors of the wrist are acting, but not as well as they should.



Treatment will now be directed towards making these muscles stronger if possible, and the man will then be discharged from treatment.

Case 10. Pte .A.A. Randall, was wounded in the hand between the 2nd and 3rd metacarpals. He was admitted to Highbury on 11.2.21. There was no alteration in sensation but a spastic condition affecting the index and middle fingers, and holding them in hyper-extension. He was treated by re-education, and in a short time had regained control over the flexors of these fingers. The index remained somewhat stiff at the inter-phalangeal joints. This improved considerably under treatment and his condition is represented by the photograph of the plaster cast taken on his discharge on May 6th, 1921.

Case 11. 6709. Pte. S. Matthews, Royal Welsh Fusiliers, was wounded in the left upper arm and hand, May 1915. He had operations, he said, immediately after the wound for swelling of the hand and tubes were inserted. His hand was bandaged for two months and when the bandages were removed he found it in the position shown - accoucheur's hand, with the wrist partly flexed. He first reported at Highbury in March, 1921. He said he had a numb feeling in the hand and it perspired freely. No nerve injury was discovered on examination.

This man was treated by suggestion, and attempts were made to bring about relaxation of the spastic muscles. Some little success was achieved, but the alterations in the ligaments etc. rendered it

necessary to adopt other measures than suggestion. Splints were accordingly applied to bring the fingers back to position and active and passive movements of the joints made.

His condition in September 1921 showed much improvement on that in March, but it will be necessary to continue the treatment some time longer before a useful hand can be restored to him. Even so the damage done is so severe that a return to anything like the normal is now out of the question. (See Photograph).

Case 12. 37027. Pte. D. Richards, South Staffs Regt., was wounded in the left upper arm in April 1918. He commenced treatment at Highbury on 28/4/20. His condition then was that there was wrist-drop with flexion of the fingers. (See Photograph). The index and middle fingers were acutely flexed with the nails embedded in the palm of the hand. The other fingers were less acutely contracted and allowed of a little passive movement. There was no voluntary power in the wrist or hand.

The only nerve lesion discovered by an electrical test was that the first and second Lumbricals did not react to faradism and there was anaesthesia of the tip of the index finger. There was however, considerable trophic disturbance of the index as shown by the glossy skin and brittle nail. No movement was possible in the proximal interphalangeal joint of the index.

Re-education of the hand was given and the wrist-drop was corrected. Extension of the fingers and

thumb was still weak. The index finger was so badly damaged that it had to be amputated at the proximal interphalangeal joint.

His condition in September 1920 was as shown in the second photograph of a cast taken then. The function of the hand is good with the exception of the extension of the fingers which is weak. He will continue with treatment in order to improve the extensors, but if this is not successful a tendon transplantation will be performed.

Case.13. 267485. Pte. A.E. Jones, South Wales Borderers, was wounded in the left forearm in January, 1917. There was no injury to the main nerves but his hand was kept for some months in a splint on account of sepsis. The wound healed five months after being received.

The photograph shows the position of the hand. The metacarpo-phalangeal joints were stiff, the extensor tendons of the fingers were shortened and the capsules of the M.P. joints light. He was treated by re-education and then plaster and felt wedges, and afterwards massage and baths with a retaining bar. The photograph shows the end result of treatment, showing normal range of movement.

This was a functional case in which secondary changes in the metacarpo-phalangeal joints had taken place, following prolonged immobilisation. Psycho-therapeutic treatment was in itself insufficient to restore the function of the hand.



Case 14. 38128. Pte. J. Nolan, East Yorks Regt., was wounded by a shell in September 1917. He was blown up and had a slight grazing wound across the back of the knuckles of the index, middle and ring fingers of the left hand. He did not remember being taken to Hospital and has forgotten everything that happened until 15 months later when he was in Hospital at Bradford. He was treated at various Hospitals and was admitted to Highbury in July 1920. He was then unable to use the hand at all, and had no power over either flexors or extensors of the fingers. All muscles re-acted to faradism.

Psycho-therapeutic treatment has been of no avail. He was discharged to another Clinic in June 1921. I examined him on September 30th, 1921, and there was still no function in the hand.

It would appear that this is a case of reflex contr acture. Failure to bring about any improvement has not been confined to one Medical Officer, as at least four men who are accustomed to treat this class of case have attempted to treat the condition, without result.

SUMMARY.

Contractures arising from wounds or injuries fall into three principal groups:-

(1) The contracture is entirely due to the lesion - generally of a nerve. If it is the result of a peripheral nerve lesion it is due to the unopposed action of the muscles antagonistic to those supplied by the injured nerve. If it is due to injury to muscle, tendon, or ligaments, it is caused by the replacement of the normal tissue by fibrous tissue which has a tendency to contract.

(2) The contracture is of functional origin, coming on immediately after the injury or after a short period of meditation. The wound serves as a constant source of suggestion of contracture and this is reinforced and firmly installed in the mind by immobilisation and disuse, till after a time myogenic and arthritic changes occur.

(3) The contracture is partially organic and due to injury to a nerve, but there is a large halo of functional disability which can be cured by psychotherapy.

The following points should be cleared up in making a differential diagnosis: -

(1) The time which elapsed between the wound or injury and the appearance of a contracture.

(2) Whether there was loss of sensibility or not; if so, did it correspond with the anatomical distribution of any sensory nerve?

(3) Whether any operation for suture of a

(nerve

nerve was performed on any projectile removed.

(4) Whether the limb was immobilised in a splint.

(5) The electrical reactions of the muscles on both sides of the limb. In organic contracture there will be indications of a lesion of the nerve supplying the opposing muscles; in functional contracture there is hypertonicity of muscles causing the contracture.

The results obtained by the use of plaster-of-Paris splints in the gradual correction of organic contractures have been very satisfactory. The advantages of this method are

(1) The gradual character of the process does not produce the severe local reaction which is found when stiff joints are mobilised by forcible manipulations under anaesthesia.

(2) The process being spread over a longer period the result is more permanent in character and is less liable to relapse when the splints are removed.

(3) Contractures which it would be impossible to correct by manipulations under anaesthesia can be overcome by this means. Also the distortion can often be fully removed whereas by other means it may be only partially effected.

(4) Some patients have a strong antipathy to being anaesthetised. These men never have any objection to plaster treatment.



After correction by plaster of contractures due to musculo-spiral paralysis, transplantation of tendons not only prevents a recurrence but also results in restoring the function of the hand almost to normal.

Functional contractures usually present no serious difficulty. Those which do are long-standing cases in which secondary changes have appeared as the result of prolonged immobilisation. The sensory and trophic changes which occasionally accompany such cases usually disappear on restoration of function.

Certain cases of reflex contracture are very difficult to treat and the results are most disappointing. The diagnosis of a reflex contracture is usually arrived at by the inefficacy of psycho-therapeutic treatment, obvious organic lesions having been excluded.



1st Stage



2nd Stage



3<sup>rd</sup> stage



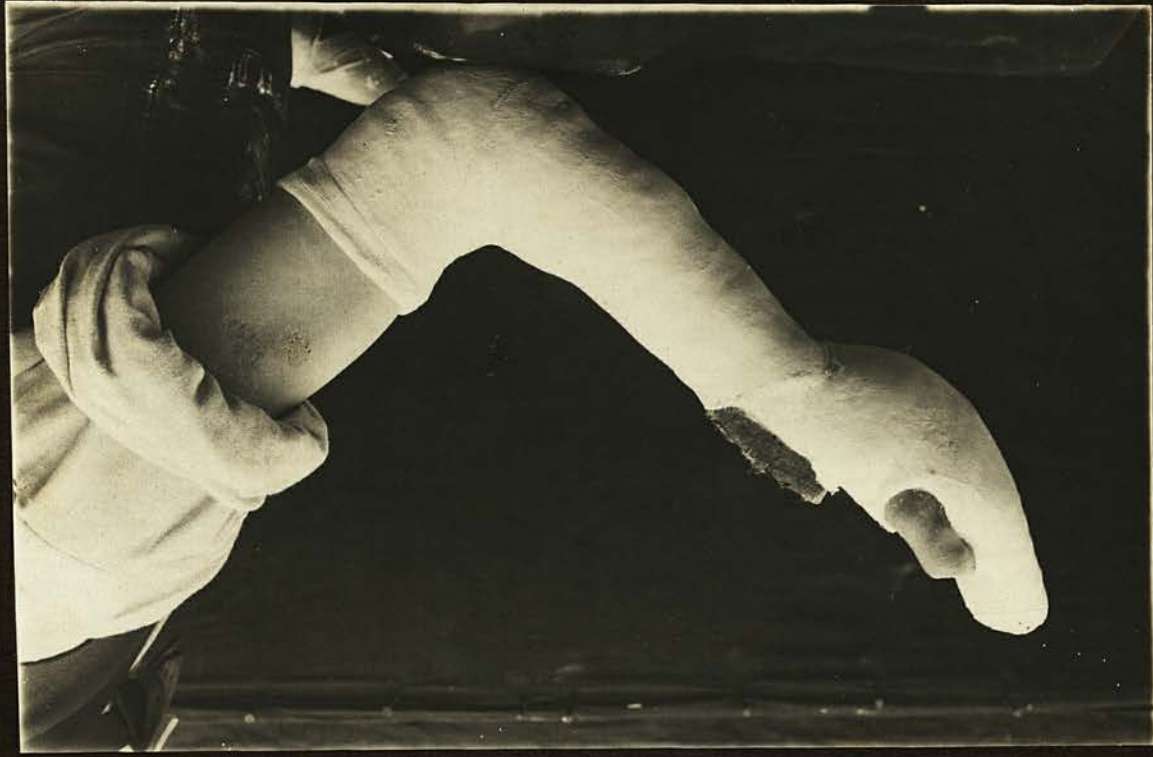
4<sup>th</sup> stage



Plaster cast of contralateral



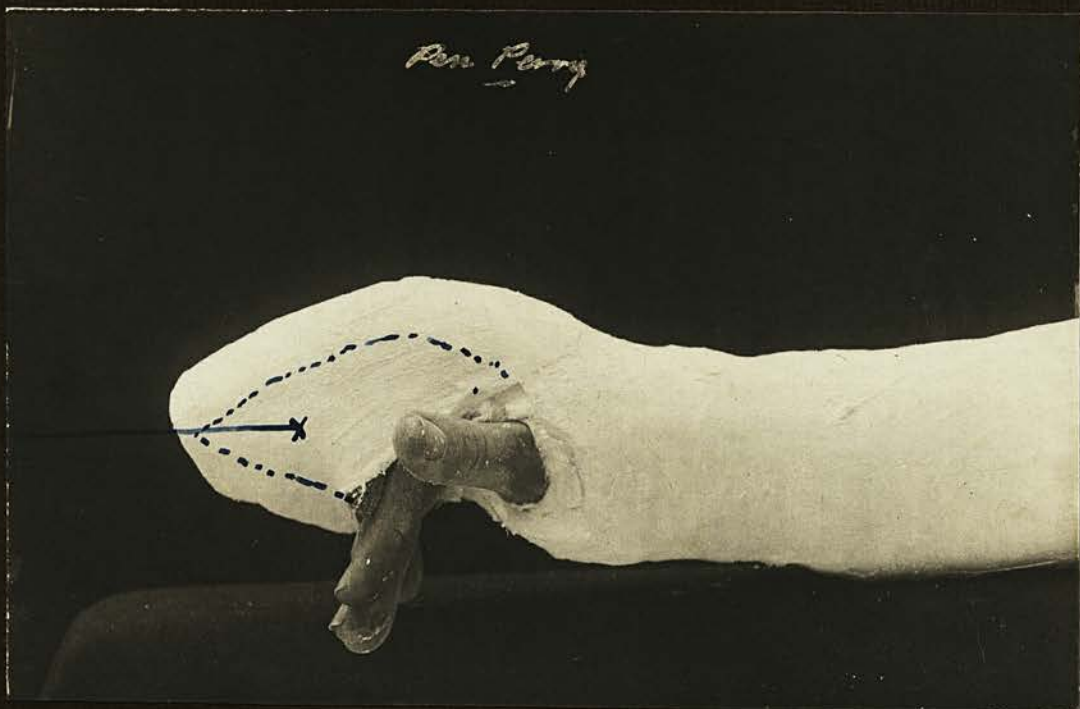
3rd stage



6th stage

Plaster correction of stiff metacarpal-phalangeal joints

Pen Perry



Left - Position  
used by  
of plaster  
cast

Pen Richards



Similar to  
above



Plaster correction of stiff metacarpal-phalangeal joints

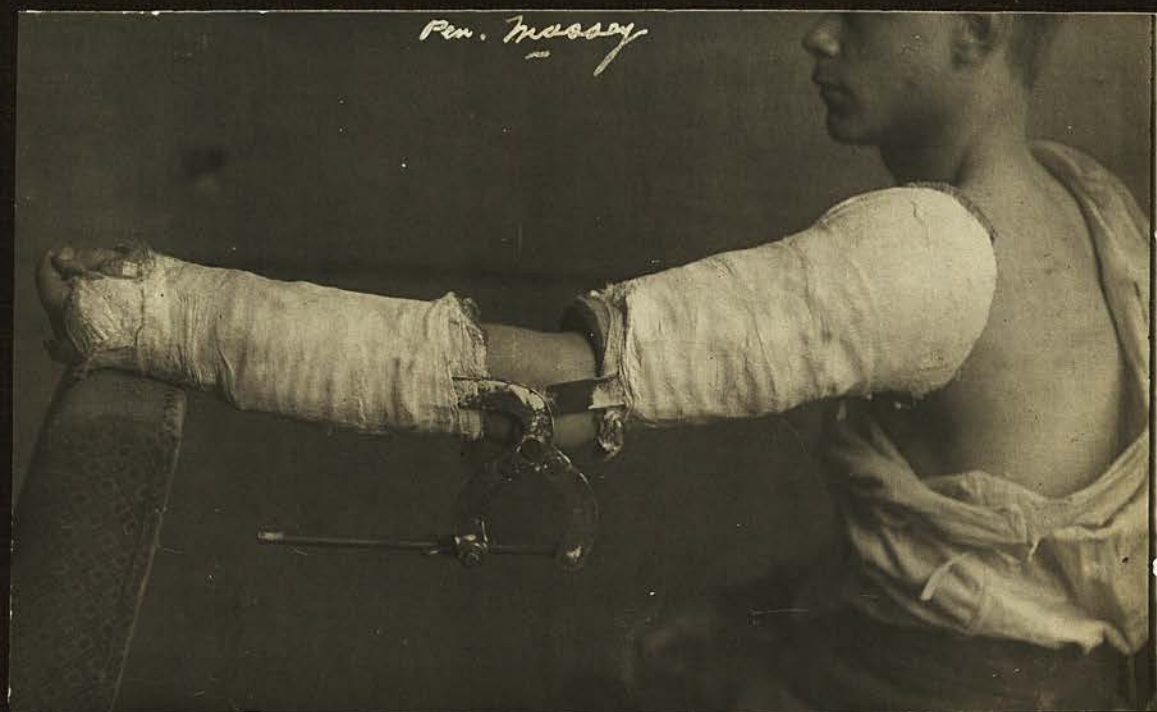


Fingers  
completely  
fixed.  
Plaster  
should not  
be removed  
and the  
retaining  
bar applied.



Retaining  
bar in  
position.  
To be applied  
to hold the  
cast down  
fixed.  
Bar held  
in position  
by metal  
rod and  
spring.





*Turner's Splint*

On Admission

On discharge



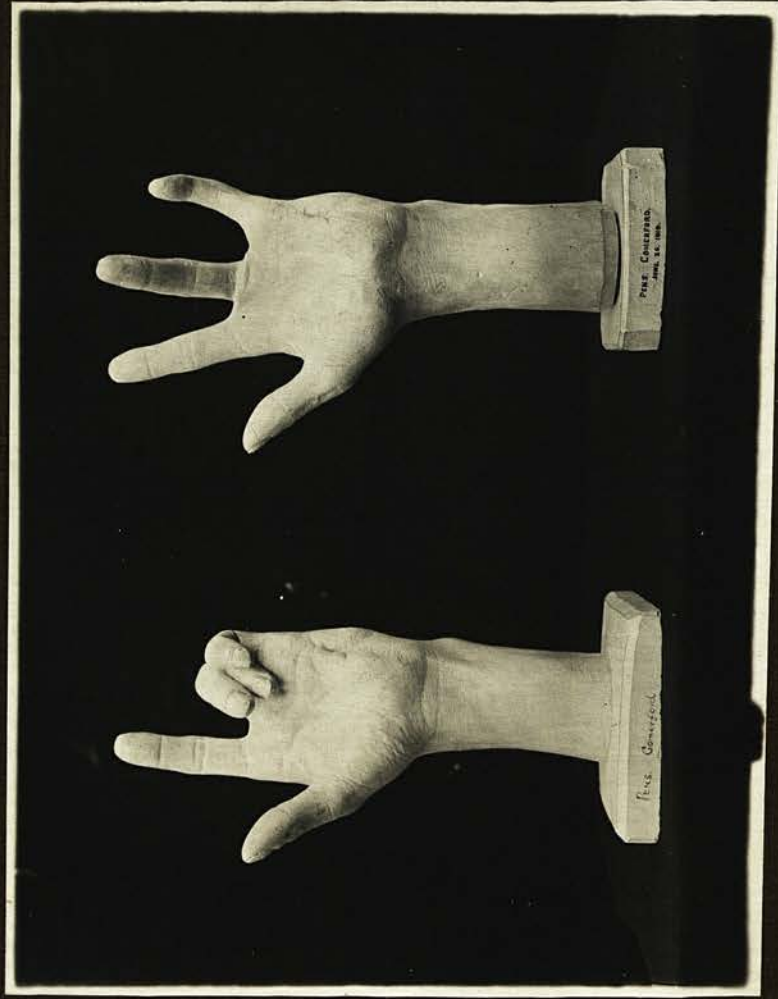
Functional  
Contracture  
(p. 29.)



Organic  
contracture  
(p. 21.)

On Admission  
Loss cast  
irreversible

On discharge  
Photograph of  
actual hand



contracted following lesion of ulnar nerve. The  
 ring finger had to be amputated. Contracted by  
 plaster of Paris splints. (p. 22.)

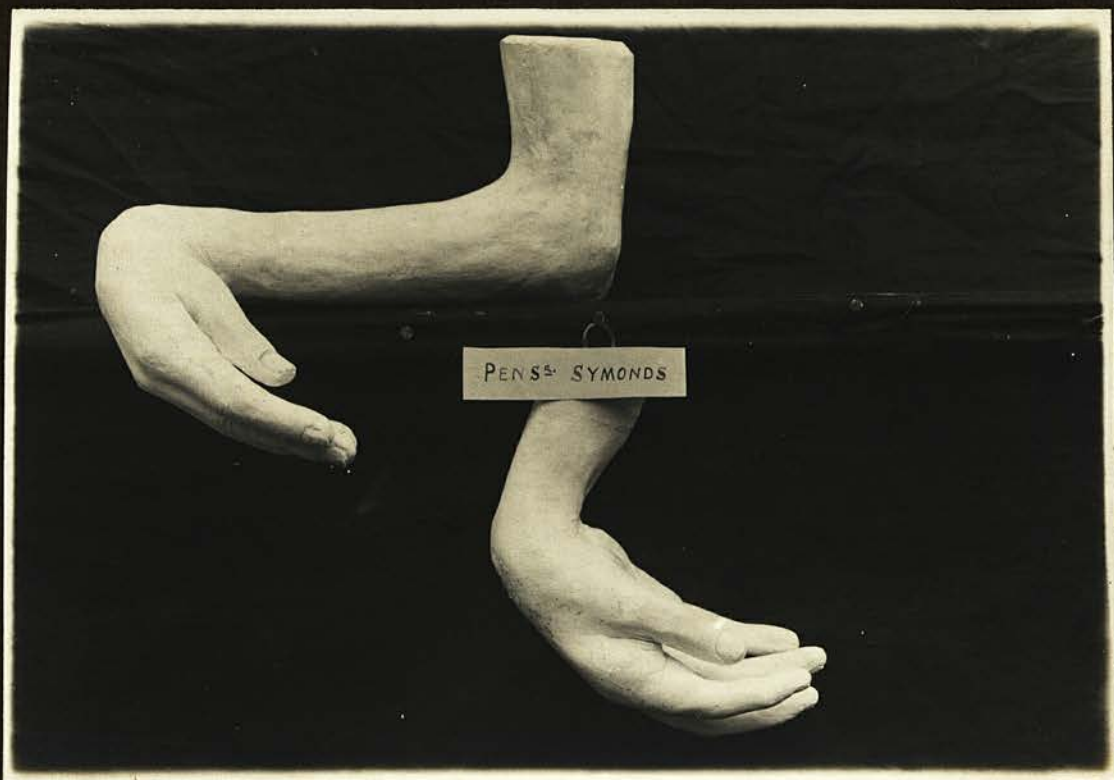


On admission

On discharge



Functional  
contracted  
(p 26.)



Functional  
contracted  
(p 28.)

On admission

A few days later



Photographs of plaster casts of Penness Lilley taken at various stages in the treatment. The first photograph shows the condition on admission 3.9.19 and the last 12.1.20. The extreme distortion of the little finger will be noted.

Functional Contracture with  
secondary changes in little finger from  
prolonged immobilisation. (P.27.)



On discharge.

On admission.



Functional contracture - anconeus's head  
 is changed with perfect fusion (D. 27.)



# Functional contracture



Condition  
on admission

Peter Siddaway

8/2/21



Cured in  
a few days  
Function of  
hand now  
excellent

(p. 27)

On admission

On discharge

functional contracture with  
secondary changes in hand

Reflex contracture



No improvement has been  
shown in spite of treatment  
(p. 32.)



A certain amount of improvement  
has been made but the hand  
cannot be restored to anything  
like normal. (p. 30.)



This was finally a functional condition. Photographs show  
 the stages of treatment. The forefinger had to be amputated  
 from a severe distortion. But is complete as shown by  
 model to which it is attached. (p. 20.)



Functional contourure with secondary  
changes in metacarpals - Metacarpal joints  
Treated by physiotherapy - in plaster shell  
(p. 31)





Musculo-  
Spiral  
Paralysis

Showing results of tendon transplantation  
for drops with



Pain Williams

Contracture in a paraplegic showing  
position of foot — partly the result of  
pressure by bedclothes.



Photographs accompanying  
Thesis for M.O. exam<sup>n</sup>  
University of Edinburgh  
by  
J. Stanley Lloyd

